

# Pathologists' Corner

## Le coin des pathologistes

### “What’s up, Doc?”

Andrew L. Allen, Uneeda K. Bryant

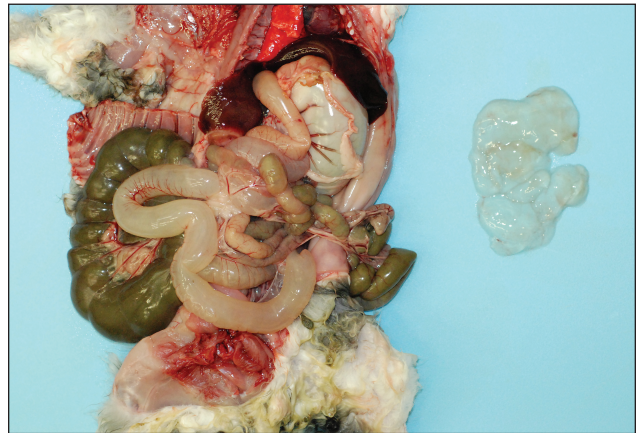
The owner of several pet rabbits presented 2 of them (1 alive and 1 dead) to a veterinary practitioner in the hope of receiving a diagnosis for the problems the rabbits were experiencing and, possibly, a treatment for the remaining rabbits. The owner reported that several of the rabbits in the group had developed a swollen abdomen and passed a mucoid substance from the anus prior to dying. The dead rabbit, a 7-week-old female, was forwarded to the Livestock Disease Diagnostic Center of the University of Kentucky for postmortem examination.

The rabbit was moderately dehydrated but, otherwise, in fair to good body condition. The abdomen was distended and the stomach contained moderate amounts of water and mucus. Portions of the small intestine and colon appeared pale, thin-walled, and translucent due to being filled and dilated with a clear, mucoid substance (Figure 1). The cecum was firm and impacted with ingesta.

Histopathologic examination of the small intestine confirmed the presence of large amounts of mucinous material admixed with very large numbers of bacteria, plant material, sloughed enterocytes, and massive numbers of coccidian parasites in various stages of their life cycle. Coccidian parasites were also present within the lamina propria (Figures 2A and 2B). There was little evidence of inflammation. Various forms of coccidian parasites were also present within hyperplastic and dilated bile ducts of the liver.

Examination of feces from the rabbit revealed oocysts (too numerous to count) of various *Eimeria* species. There are at least 12 *Eimeria* species that affect rabbits with at least 11 species that infect cells of the intestine with varying degrees of pathogenicity (1,2). Aerobic and anaerobic culture of the contents of the intestine yielded nonpathogenic bacteria and other saprophytic microorganisms.

Based on these findings, the rabbit was diagnosed as having intestinal coccidiosis involving mixed *Eimeria* sp., hepatic



**Figure 1.** The abdominal contents of a 7-week-old, female, pet rabbit with mucoid enteropathy. Portions of the small intestine and colon appeared pale, thin-walled, and translucent because they were filled and dilated with clear mucus. A sample of the contents of the intestines, the clear, gelatinous material, is present at the right of the image.

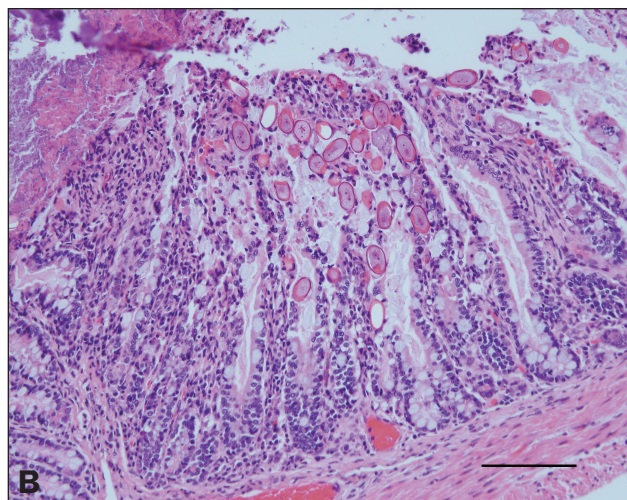
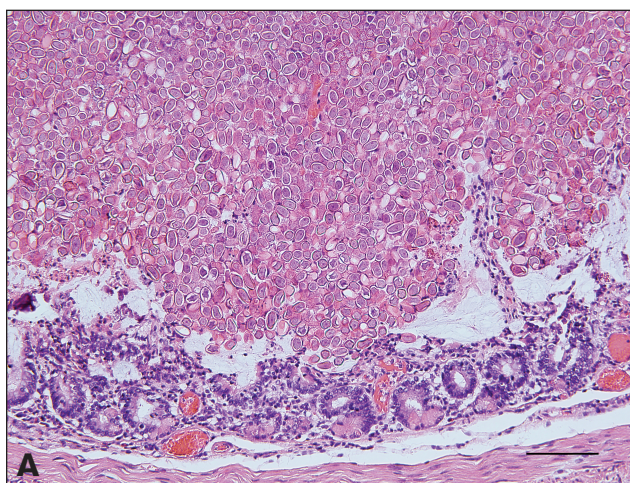
coccidiosis caused by *Eimeria stiedae*, and mucoid enteropathy. Mucoid enteropathy is a widely recognized and well described problem of domestic and captive rabbits (1,2). The term “mucoid enteropathy” is a nonspecific, descriptive term that refers to what are likely different, but related, enteric diseases in which there is marked secretion of mucus in the intestines with minimal or no evidence of inflammation. Mucoid enteropathy is also known as mucoid enteritis; however, the term “mucoid enteritis” is also used by rabbit fanciers and others to refer to any condition in which rabbits produce mucoid diarrhea or feces with an increased coat of mucus. In these situations, there is usually evidence of injury and inflammation of the intestine caused by pathogenic microorganisms (1,2).

Rabbits affected with mucoid enteropathy are typically between 7 and 10 weeks of age, but adults can be affected. While various studies have produced several theories about the cause of the disease, the etiology and pathogenesis remain poorly understood. A common suggestion is that rabbits fed a diet low in indigestible fiber are predisposed to the disease. The rate of morbidity due to mucoid enteropathy in a group of rabbits is variable, but may be high. The case fatality rate is often high, reportedly 60% to 100%, regardless of the treatment employed (1,2).

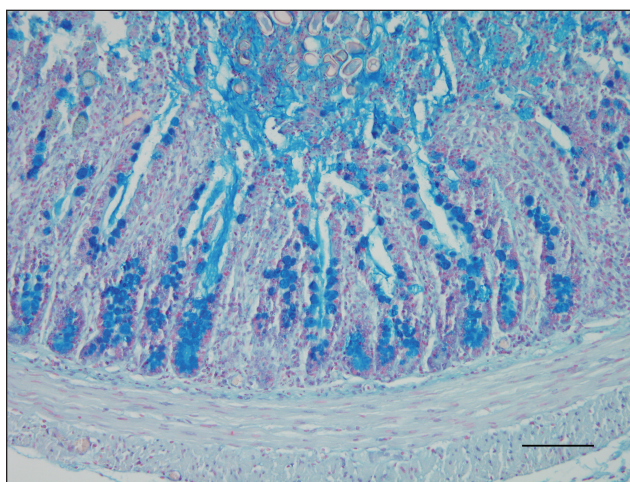
The postmortem findings in rabbits with mucoid enteropathy typically include the distention of portions of the small intestine

Department of Veterinary Pathology, Western College of Veterinary Medicine, University of Saskatchewan, 52 Campus Drive, Saskatoon, Saskatchewan, S7N 5B4 (Allen); Livestock Disease Diagnostic Center College of Agriculture, University of Kentucky, 1490 Bull Lea Road, Lexington, Kentucky 40511, USA (Bryant).

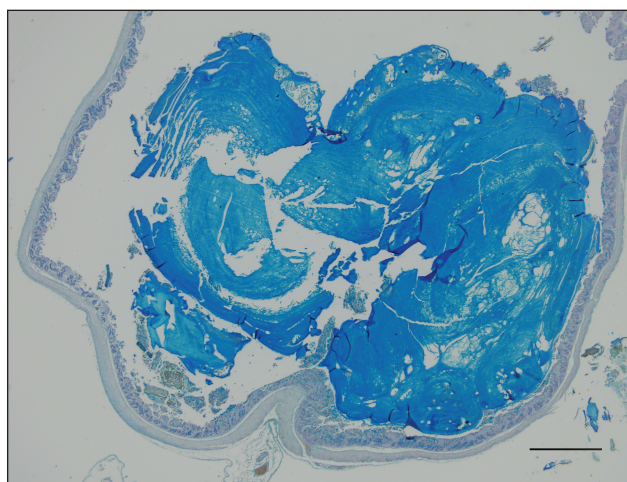
Use of this article is limited to a single copy for personal study. Anyone interested in obtaining reprints should contact the CVMA office (hbroughton@cvma-acmv.org) for additional copies or permission to use this material elsewhere.



**Figures 2A and 2B.** Histologic sections of the small intestine from the rabbit in Figure 1. There are massive numbers of oocysts of *Eimeria* species within the lumen (A) and mucosa (B). Hematoxylin and eosin. Bar = 100  $\mu$ m for both.



**Figure 3.** Histologic section of the small intestine of the rabbit in Figure 1. Alcian blue stains the glycoproteins in mucin blue. Note the large number of mucin containing goblet cells in the mucosa and the mucin being secreted into the intestinal lumen. There are also several oocysts of *Eimeria* species in the intestinal lumen at the top of the image. Alcian blue. Bar = 100  $\mu$ m.



**Figure 4.** Histologic section of the colon from the rabbit in Figure 1. The colon is filled with mucus that contains blue staining glycoproteins. Alcian blue. Bar = 1 mm.

and colon with translucent fluid, mucus, or both, and impaction of the cecum with dry ingesta, as was seen in the rabbit discussed herein. Histologically, as illustrated in this case (Figures 3 and 4) there is goblet cell hyperplasia in the mucosa of the small and large intestine with release of extremely large amounts of mucin into the intestinal lumen. As noted above, there is little, if any, associated inflammation (2).

Goblet cells are well-differentiated cells present within the intestinal epithelium (and other mucus membranes). Goblet cells produce and secrete mucins, a family of high molecular weight glycoproteins. Once secreted, mucins hydrate and gel to form mucus. Mucus lubricates the intestines and also serves as a barrier to protect the intestinal mucosa against harmful chemicals, microorganisms, and microbial products, including toxins. Secretion of stored mucin and goblet cell hyperplasia occur in response to a variety of stimuli that include chemical and physical irritation, and inflammation (3–5).

Because the cause and pathogenesis of mucoid enteropathy is uncertain, recommendations for treatment of affected animals and for the prevention of further disease are empirical. These recommendations include the correction of any problem that may lead to the disruption of intestinal function, such as: stasis and impaction of the cecum, or imbalance of intestinal microflora referred to by some as dysbacteriosis or dysbiosis (5). Disruption of intestinal function in rabbits has been associated with stress, that may occur from weaning, transportation, changes in the environment, and perceived threats (1). While kits are sometimes weaned as early as 25 days of age (1), it appears to be more common to wean pet rabbits between 5 and 7 weeks of age. Dysbiosis in rabbits is thought to result from a variety of factors and includes the administration of antimicrobial drugs and a change in the diet, particularly a change to a diet high in energy, low in fiber, or both. The high incidence of mucoid enteropathy in 7- to 10-week-old

rabbits may be related to recent weaning, a change in diet, or both.

In this case, the referring veterinarian and owner were advised to ensure that the rabbits' diet contained appropriate amounts of fiber and that they had free access to water. It was also suggested that the rabbits be treated for coccidiosis and that measures be implemented to prevent or minimize future infections.

In summary, the history, clinical findings, and distinctive postmortem findings associated with mucoid enteropathy in rabbits should allow for the diagnosis in most instances. To address the problem, a review of the management practices should be conducted and appropriate changes instituted. The review should include diet composition and any recent changes in feeding practices, as well as any other event that might have contributed to the disruption of the intestinal microflora, such

as: administration of antimicrobials or concurrent disease. Ancillary tests, such as fecal floatation, histopathology, and bacterial culture, can also be performed to investigate the potential role of pathogens (2).

## References

1. Saunders RA, Davies RR. Notes on Rabbit Internal Medicine. Oxford, UK: Blackwell Publ, 2005:19–24;105–141;179–183.
2. Percy DH, Barthold SW. Pathology of Laboratory Rodents and Rabbits. 3rd ed. Ames, Iowa: Blackwell Publ, 2007:253–307.
3. Specian RD, Oliver MG. Functional biology of intestinal goblet cells. *Am J Physiol (Cell Physiol)* 1991;260:C183–C193.
4. Brown CC, Baker DC, Barker IK. Alimentary system. In: Maxie MG, ed. *Pathology of Domestic Animals*. 5th ed. Vol 2. Toronto: Saunders Elsevier, 2007:1–296.
5. Hawrelak JA, Myers SP. The causes of intestinal dysbiosis: A review. *Altern Med Rev* 2004;9:180–197.

## Book Review

### Compte rendu de livre

### Veterinary Comparative Hematopathology

Valli VE. Blackwell Publishing, Ames Iowa, USA. 2007. ISBN 9780-8138-0924-3. \$239.99.

**I**n the author's own words "the major purpose of this book is to define hematopoietic neoplasms in animals with comparison to those in humans where reasonable similarities exist to guide classification and understanding." In humans there are more than 30 defined types of B- and T-cell neoplasms that differ remarkably in response to treatment and behavior, yet in dogs all of those are treated as one disease.

The textbook is composed of 10 chapters primarily written by veterinary clinical pathologists and one professor of human pathology. The book begins by discussing normal and benign reactive hematopoietic tissue — lymph nodes, spleen, thymus, bone marrow. Other chapters discuss B- and T-cell neoplasms,

leukemias, myeloproliferative diseases, Hodgkin's lymphoma. Descriptions of neoplasms are broken down into presentation, histology, cytology, and phenotype. Multiple species of animals are included in this book. Descriptions of human disease counterparts are made where applicable. The text is laid out well, is easy to read, and is supported by photographs.

This textbook provides pathologists and oncologists with information to allow more specificity in both diagnostics and therapy of animal hematopoietic neoplasms. It would likely be of more interest to the aforementioned groups; however, anyone with a keen interest in hematopathology would find this text very interesting.

*Reviewed by **Troye McPherson, BSc, DVM**, Westwood Hills Veterinary Hospital, 3650 Hammonds Plain Road, Upper Tantallon, Nova Scotia B3Z 4R3.*